

4. Briefly explain the purpose of the following GSM logical channels:

- a. SCH b. PCH c. RACH d. FACCH

Question (4) (20 degrees)

Choose the correct answer:

1. When the distance between MS and BS doubled, the SIR will be
a. Doubled b. Quadrupled c. Minimized d. Other
2. Increasing the frequency reuse distance will increase
a. System capacity b. Interference c. Cell size d. Other
3. The message on the DCCH including information about
a. Frequency correction b. Mobility management c. Synchronization
4. The SDCCH is used to send
a. Speech message b. Synchronization c. Authentication message
5. The combining technique in which the signals must be co-phased before combining is
a. Selective combining b. Equal-gain combining c. Other answer
6. The GSM system uses a multiple access technique known as
a. TDMA b. FDMA c. FDD d. (a, b, and c)
7. In the inter-cell-inter BSC handover, the handover is controlled by
a. The same BSC b. The different BSC c. The MSC d. Other
8. Doppler shift occurs due to
a. Multiple paths b. Motion between Ms and the BTS c. Other
9. The function of OMC is
a. Security management b. Authentication management c. Performance management.
10. Dedicated control channels are
a. Downlink b. Uplink c. Both of them
11. What is the difference between TDD and FDD technique?

Good Luck

Dr. Intesar Said

Course Title: Mobile Communication Systems
Date: 9-6- 2012Course Code: EEC4230
Allowed time: 3 hrs4th year
No. of Pages: (2)**Answer all the following questions:****Question (1) (25 degrees)**

1. What is the adjacent channel interference? How can it be minimised?
2. Explain how sectoring improves capacity in a cellular system.
3. Describe with the block diagram the Microcell concept and state the purpose from it.
4. Consider a mobile radio network has a spectrum 1060 kHz and the channel bandwidth of 50 kHz duplex channel. The SIR is 18 dB and the call duration is 120 sec. Determine:
 - a. The reuse distance and the cluster size.
 - b. The number of channels per cell
 - c. The total offered traffic if the number of users in each cell is 200 users and each user doing one call in the busy hour.
 - d. If the blocking probability is 3% determine the carried traffic and the channel efficiency.

Question (2) (20 degrees)

1. Compare between Time diversity and space diversity.
2. What is the difference between the Maximal-Ratio combining and the Equal-gain combining?
3. Assume a transmitter radiates a carrier frequency of 200 MHz and a mobile moving at a velocity of 60 m/hour, compute the received carrier frequency if the mobile is moving:
 - a. Toward the transmitter.
 - b. Away from the transmitter.
 - c. Perpendicular to the angle of arrival of the transmitted signal.

Question (3) (25 degrees)

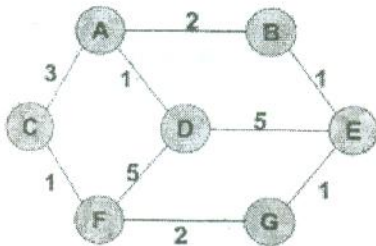
1. What is the difference between the Abis interface and the A interface?
2. State the function of the following GSM elements:
 - a. BSC
 - b. MSC
 - c. AUC
 - d. VLR
3. State the function of the following GPRS elements:
 - a. SGSN
 - b. GGSN
 - c. PCU
 - d. GTP

Question Five

1- Complete the following table for wireless networks

Item	Wi-Fi IEEE 802.11b	Wi-Fi IEEE 802.11g	Bluetooth	Wi-Max
Modulation				
Bite rate range				
Encryption/security				
Half/Full Duplex				
Frequency Carrier				
Bandwidth				

2-Given the network topology in the figure below, Using RIP (routing information protocol) finds the final routing tables at router A.



- If router G is shutdown find the same router final table at router A
- 3- A large population of ALOHA users manage's to generate 50 requests/sec, including both originals and retransmissions. Time is slotted in units of 40 msec.
- What is the chance of success on the first attempt?
 - What is the probability of exactly k collisions and then a success?
 - What is the expected number of transmission attempts needed?

Question Six

1- What is the difference between Fast Hopping and Slow Hopping Techniques?

2- Assume that an ISP has assigned 32 IP numbers to a customer in which the numbers starts with 196.150.20.0 and ends with 196.150.20.31?

- What is the network mask for this class?
- What is the sub-network mask for the given 32 IP numbers?

3- You will create a design for a network connecting four buildings in an industrial park. Hand in a picture showing your network. There will be a core switch in each building. Building A is the headquarters building. Building B is 85 meters south and 90 meters east of the headquarters building. From the headquarters building, Building C is 100 meters south. Building D is 60 meters west of Building C. Computers in Building A need to communicate with computers in Building B at 60 Mbps. Computers in Building A need to be able to communicate with computers in Building C at 300 Mbps. Computers in Building A must communicate with computers in Building D at 50 Mbps. Computers in Building C must communicate with computers in Building D at 75 Mbps. Building A will be connected directly to Buildings B and C. Building C will be connected directly to Building D.

- How will you connect Building A with Building B?
- How will you connect Building A to Building C?
- How will you connect Building C to Building D?



Answer all Questions

Question One

1- Define the following Terms:

- NIC - Protocol - DSL - ADSL - ISDN - http - WWW - FTP -AP
Multicasts - Broadcasts - IP - RFC - WEP - WPA

2- Draw a diagram of TCP/IP layers? Illustrate the functionality of each layer?

3- Draw three types of different computer network topologies

4- Represent the following signal 11001 using Manchester and differential Manchester encoding

Question Two

1-What are the differences between thin coaxial 10-base-2 and thick coaxial 10-base-5?

2- Draw the Frame format of the Ethernet IEEE 803.2

3- In the matrix below, the binary data is error checked using even parity in the last row and column. Indicate which bit(s) can be flipped in order to create an undetectable corruption of the data using the fewest bits possible. You need only show one example

0	1	1	1	1	0	1	1	0
1	1	0	1	1	1	0	1	0
1	0	1	0	1	1	1	1	0
1	1	1	1	0	1	1	0	0
1	1	1	1	1	1	1	1	0

Question Three

1- What is the network address class and network mask for each of the following addresses

- 121.50.120.7

- 178.50.87.65

- 220.54.121.90

2- Assume a frame to be transmitted using CRC codes if the message $M = 1010001101$ and the pattern $P = 110101$. Find the final bits to be transmitted according to CRC

3- Explain with the necessary drawing the operation of the following switching techniques:

- Circuit switching
- Message switching
- Packet switching

Question Four

1- A wireless LAN is working based on p-persistent system, p is given by $p = (n / (N+1))$ where n is the station number and N is the total number of WLAN stations. Assuming that $N=9$ what is the probability of a node number 6 to send its packet over an idle bus and what is the probability to defer transmission to the next time slot?

2- Explain the operation for each MAC protocol

- One -Persistent
- p- Persistent
- Bit Map Protocol
- Non - Persistent

3- What are the difference between:

- TCP and UDP transport protocol
- TCP ports and TCP sockets
- Routers and B-routers



Question.3 (16 Marks)

- a) Write a MATLAB function that takes an image *im* and a mask size *L* (the mask is assumed to be $L \times L$) as inputs and returns the image *im_new* after applying the geometric mean filter. (8 Marks)
- b) Write a Matlab code, using the MATLAB basic commands, to perform linear spatial filtering on the 'cameraman.tif' image. Your code will read the image and ask the user to input the filter coefficients, in a matrix *f* assuming fixed filter size (3x3), then apply this filter and display the output image. (8 Marks)

Question.4 (18 Marks)

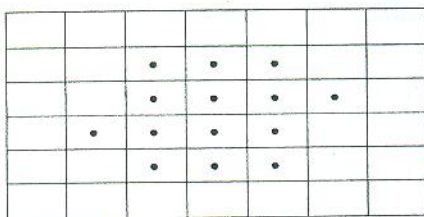
- a) A 1024 x 1024 gray image is to be smoothed. Compute the number of multiplications if the smoothing is done: (7 Marks)
- In the spatial domain using the convolution with a spatial average filter with mask size (25x25).
 - In the frequency domain using a LPF with applying the FFT approach.
 - Which is faster? Can you obtain a more general result?
- b) It is required to find the DFT of the matrix $f = \begin{bmatrix} 4 & 5 \\ 4 & -7 \end{bmatrix}$ (11 Marks)
- Apply the normal 2D – DFT law
 - Apply the FFT algorithm
 - Write the MATLAB command to apply FFT on the matrix *f* and calculate the saving factor.

Question.5 (15 Marks)

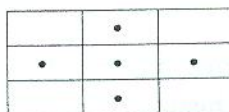
- a) Use the Hough transform to detect the strongest line in the binary image shown below. Use the form $x \cos(\theta) + y \sin(\theta) = r$ with θ in steps of 45° from -45° to 90° . Write the final equation for the strongest line you got and show it on the image. (11 Marks)

	x							
	-3	-2	-1	0	1	2	3	
-3	0	0	0	0	0	1	0	
-2	0	0	0	0	0	0	0	
-1	0	1	0	1	0	1	0	
0	0	0	1	0	0	0	0	
1	0	0	0	0	0	0	0	
2	1	0	0	0	0	1	0	
3	0	0	0	0	0	0	0	

- b) Sketch the result of the erosion operation to the image A with the structure element B. (4 Marks)



A



B



Elective Course (4): Image Processing
Date: June, 13th 2012 (Second Term)

Course Code: EEC4235
Allowed Time: 3 hrs

Year: 4th
No. of Pages: (2)

Answer the following Questions:

Question.1 (21 Marks)

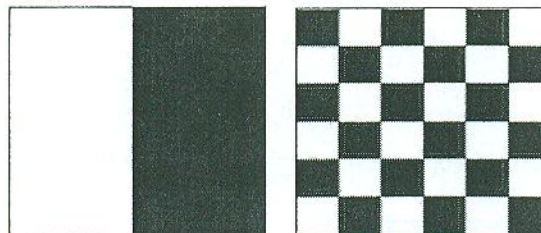
- a) If an image is resized with a factor (1/16), then resized with a factor 16, would the original image be obtained? Explain. (3 Marks)
- b) State the operation(s) and write the suitable MATLAB commands to: (11 Marks)
- Detect a missing object between two images *im1*, *im2*.
 - Remove salt and pepper noise from an image *im*.
 - Detect an object *inner* boundary in a black and white image *im*.
 - Breaking the thin lines in a black and white image *im* without affecting the larger objects.
- c) Assuming that the matrix *im* contains a gray scale image data with size M x N, It is found that all the pixel values are between 100 and 200: (7 Marks)
- i. What do think the function of the code below?

```
for i=1:M
    for j=1:N
        imnew (i , j) =(255-0)/(200-100)*(im (i , j)-100);
    end
end
```

- ii. Implement the same function using a look up table.
- iii. Compare the two methods in terms of speed considering the number of operations required.

Question.2 (15 Marks)

- a) The images shown are quite different, but their histograms are identical. The black level is 0 and the white is 255 in both images. Suppose that each image is blurred with a 3x3 smoothing mask: (5 Marks)
- Would the histograms still be identical after blurring?
 - Explain your answer indicating what you expect about the resulting histograms. Make any suitable assumptions that may help.



- b) What is the difference between the contrast stretching using **imadjust** command and histogram equalization using **histeq**? (4 Marks)
- c) When the filter is said to be separable? What is its advantage? Is the 3x3 median filter is separable? Why? (6 Marks)

(b) Check whether the received signal "0010111010101100" is error-free or not using Hamming code (16, 11), where the Hamming bits are in positions 1, 2, 4, 8, and 16.

(c) Determine the parity check matrix for a (7, 4) code, using P matrix as follow:-

$$P = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$$

What is the information message if the received codeword is "1110001".

Question (4)

(a) A continuous transmission channel has the following joint probability density function.

$$P(x, y) = \begin{cases} 6e^{-2x-3y} & x, y > 0 \\ 0 & \text{o.w} \end{cases}$$

- (i) Define the channel type.
- (ii) Calculate $h(x)$, $h(y)$ and $I(x; y)$.

(b) A terminal is used to enter alphanumeric data into a computer through a telephone channel of 3400 Hz. It is found that the obtained channel rate is 14929 bit/sec. Determine the following:-

- (i) S/N in dB.
- (ii) If the channel bandwidth is doubled, what will be the required S/N for the same channel rate?

(c) Construct a convolution encoder with the commutator samples $C_1 = D_1$, $C_2 = D_1 \oplus D_2$, and $C_3 = D_1 \oplus D_2 \oplus D_3$. The data input stream is 1011. Find the message coded by the encoder.

Best Wishes of Success

Course Title: Information Theory
Date: 18/6/2012 (Second Term)Course Code: EEC4237
Allowed time: 3 hoursYear: 4th
No. of Pages: (2)

Remarks: (answer the following questions, assume any missing data, answers should be supported by sketches, Neat answers and boxed results are appreciated)

Question (1)

- (a) Define the following codes: Prefix code, non-singular code, unique decodable code, and instantaneous code. Give an example for each.
- (b) A source with seven symbols with the probabilities $[P(x)] = [0.4, 0.2, 0.12, 0.08, 0.08, 0.08, 0.04]$. Determine the following:-
- Huffman code using 2-symbols at a time and evaluate the code.
 - Repeat (i), using 3-symbols at a time.
 - Comment on your results obtained from (i) and (ii).

Question (2)

- (a) Show that the mutual information of a channel is symmetric.
- (b) A transmission channel has the following matrix;

.....	0.08	0.13
0.06	0.09
0.14	0.12
.....	0.04	0.06

With source probabilities $[P(x)] = [0.25, \dots, 0.4, 0.17]$. Determine the following:-

- The source efficiency and channel efficiency.
- The channel capacity.
- Construct both the joint and transition matrices of the opposite type of channel.
- Calculate the average amount of lost information on receiving a message of 30 symbols.

Question (3)

- (a) Consider a code with the following P matrix;

$$P = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

- Determine the minimum size n of the codeword?
- Which of the following is a codeword; (1001101), (0101100)?
- Find the codeword C for the given message (1010). What is the Hamming weight of the resulted codeword?
- If the fifth bit of the received codeword is 1, check if an error has occurred or not. If so, how does the decoder know the position of the erroneous bit?

Question (4)

- (a) **Draw** the I-V characteristic curve of the tunnel diode. **State** the necessary conditions for electron tunneling.
- (b) **Explain** with the aid of the energy band diagrams the appearance of the negative resistance of the tunnel diode. (**Draw only the 3 cases within the range of forward bias voltage $V_P \leq V \leq V_V$**).
- (c) A tunnel diode equivalent circuit has the following parameters; $R_s = 4\Omega$, $c_j = 1PF$, and negative resistance of $R_j = -70\Omega$. The diode is placed in a cavity to operate as an amplifier at $f = 3GHz$. The total cavity capacitance is $C_c = 2.5PF$ with load and source resistances $R_L = R_g = 50\Omega$. Find the following:
1. The equivalent negative conductance of the diode at that frequency.
 2. The amplifier power gain.
 3. The amplifier bandwidth.
 4. The frequency at which the equivalent conductance of the diode vanishes.

Question (5)

A GaAs MESFET amplifier has the following parameters: $Z_0 = 50\Omega$, $s_{11} = 0.65\angle -140^\circ$, $s_{22} = 0.7\angle -65^\circ$, $s_{12} = 0.04\angle 60^\circ$, and $s_{21} = 2.4\angle 50^\circ$.

1. Check the stability of the amplifier.
2. Design the input and output matching networks of the amplifier for maximum gain using short circuited shunt stub. Draw the amplifier circuit.
3. Calculate the amplifier transducer gain G_{Tmax} .

Use the following relations and table

$$k = \frac{1 - |s_{11}|^2 - |s_{22}|^2 + |\Delta|^2}{2|s_{12}s_{21}|}, \quad \Delta = s_{11}s_{22} - s_{12}s_{21}$$

$$\Gamma_{MS} = \frac{B_1 \pm \sqrt{B_1^2 - 4|C_1|^2}}{2C_1}, \quad C_1 = s_{11} - \Delta s_{22}^*$$

$$\Gamma_{ML} = \frac{B_2 \pm \sqrt{B_2^2 - 4|C_2|^2}}{2C_2}, \quad C_2 = s_{22} - \Delta s_{11}^*$$

$$B_1 = 1 + |s_{11}|^2 - |s_{22}|^2 - |\Delta|^2$$

$$B_2 = 1 + |s_{22}|^2 - |s_{11}|^2 - |\Delta|^2$$

$$G_{Tmax} = \frac{1}{1 - |\Gamma_{MS}|^2} |s_{21}|^2 \frac{1 - |\Gamma_{ML}|^2}{|1 - s_{22}\Gamma_{ML}|^2}$$

Bessel function table

x	$J_1(x)$
0.814	0.3689
0.916	0.406
1.22	0.499
1.95	0.579

With my best wishes

Answer the following five questions: (Time: 3 hours)

Question (1)

- (a) Why the performance of the conventional tubes is impaired at microwave frequencies. Derive the expression of triode input impedance under the effect of the electrons transit angle θ_g .
- (b) The parameters of a two cavity klystron amplifier are:
 $V_0 = 1200 \text{ V}$, $I_0 = 28 \text{ mA}$, $f = 8 \text{ GHz}$, $L = 4 \text{ cm}$, $d = 1 \text{ mm}$, $R_{sh} = 40 \text{ K}\Omega$
- 1- What is the value of the input microwave voltage V_1 required to generate a maximum output voltage V_2 .
 - 2- What is the voltage gain in dB.
 - 3- What is the efficiency of the amplifier. **Comment** on the answer.
 - 4- Compute the beam loading conductance and show that it can be neglected in the above calculations.

Question (2)

- (a) For a reflex klystron oscillator RK, **derive** an expression for the electrons round trip time ($t_2 - t_1$). **State** the necessary condition for maximum energy transfer from the electrons to the cavity.
- (b) A reflex klystron oscillator operates under the following conditions:
 $V_0 = 600 \text{ V}$, $R_c = 30 \text{ k}\Omega$, $R_L = 30 \text{ k}\Omega$, $f_r = 9 \text{ GHz}$, $L = 1 \text{ mm}$. The tube is oscillating at the peak of the lowest order mode. Assume that the transit time τ_g through the gap and the beam loading can be neglected.
1. Find the value of the repeller voltage V_r .
 2. Find the direct current I_0 necessary to give microwave output power of 166.66 mW.
 3. Determine the electronic and circuit efficiency.

(Hint: use the Bessel function table in the second paper)

Question (3)

- (a) **Draw** the block diagram of the TWT. **Describe** with drawing the amplification process.
- (b) A travelling wave tube is operating at 5GHz, with an output power of 40 dBm. The helix length is $L = 24 \text{ cm}$ and the tube has a growing factor of 1.5 dB/cm. The beam voltage is $V_0 = 3000 \text{ V}$, the beam current is $I_0 = 30 \text{ mA}$, the helix impedance is $Z_0 = 10 \Omega$. Find:
1. The ac input power and dc input power.
 2. The efficiency of the TWT amplifier.
 3. The attenuation in dB.